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Chrono: A System for Normalizing Temporal Expressions

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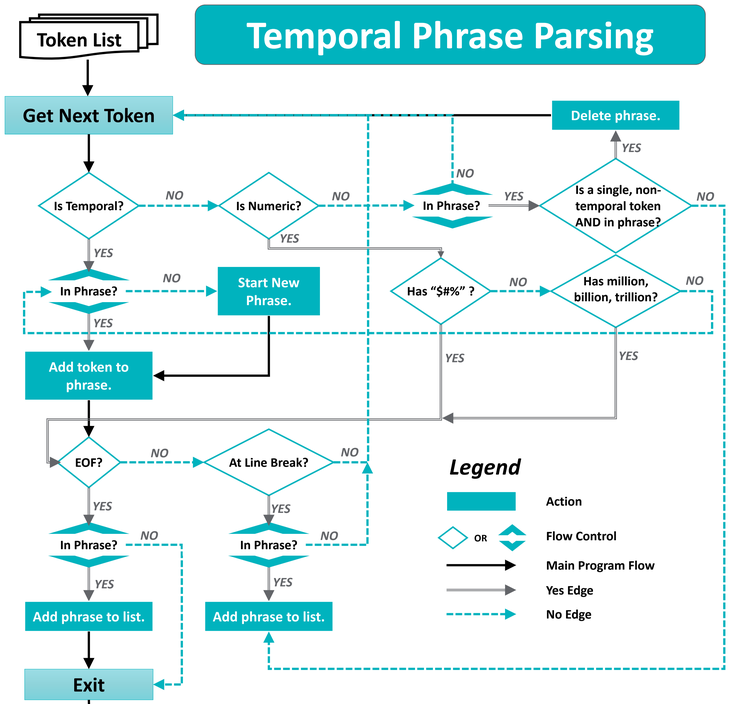
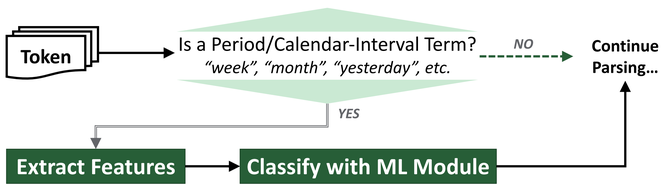
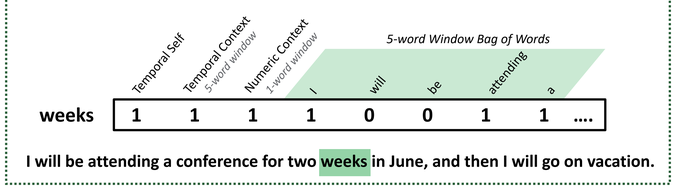
Temporal Phrase Parsing



Temporal Disambiguation with ML



Feature Vector Example



Available algorithms: Naïve Bayes *(NLTK),* Decision Tree *(NLTK),* Support Vector Machine *(SciKitLearn, C = 0.05, maximum iterations = 3),* Neural Network *(Keras, Feed-forward network, 3 hidden layers, Epoch = 5, batch = 10)*

Training: 81 Newswire Documents from SemEval Training Corpus with 5-fold cross validation.

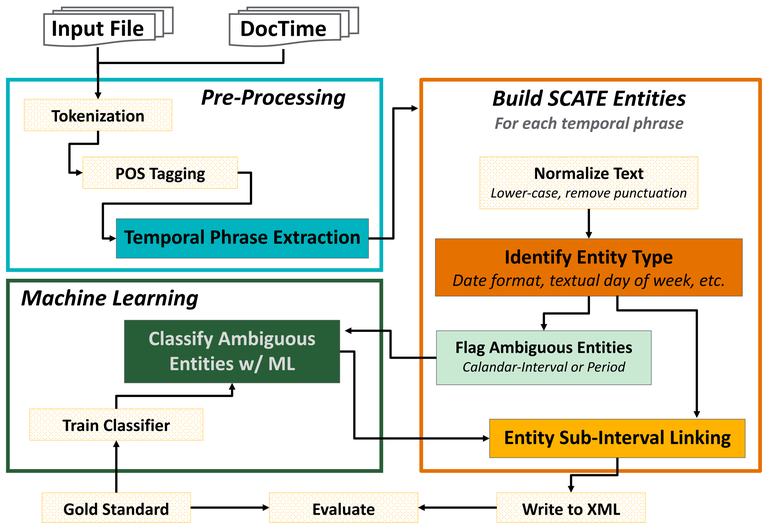
References:

[1] Olex AL, Maffey LG, Morton N, and McInnes BT. "Chrono at SemEval-2018 Task 6: A System for Normalizing Temporal Expressions." In *Proc. 12th Int. Workshop on Semantic Evaluation*, SemEval'18, New Orleans, LA, USA, Association for Computational Linguistics.

[2] Bethard S and Parker J. "A semantically compositional annotation scheme for time normalizations." (2016) In *Lrec*, pages 3779-3786.

[3] Laparra E, Xu D, Bethard S, Elsayed AS, and Palmer M. "Semeval 2018 task 6: Parsing Time Normalizations." In *Proc. 12th Int. Workshop on Semantic Evaluation*, SemEval'18, New Orleans, LA, USA, Association for Computational Linguistics.

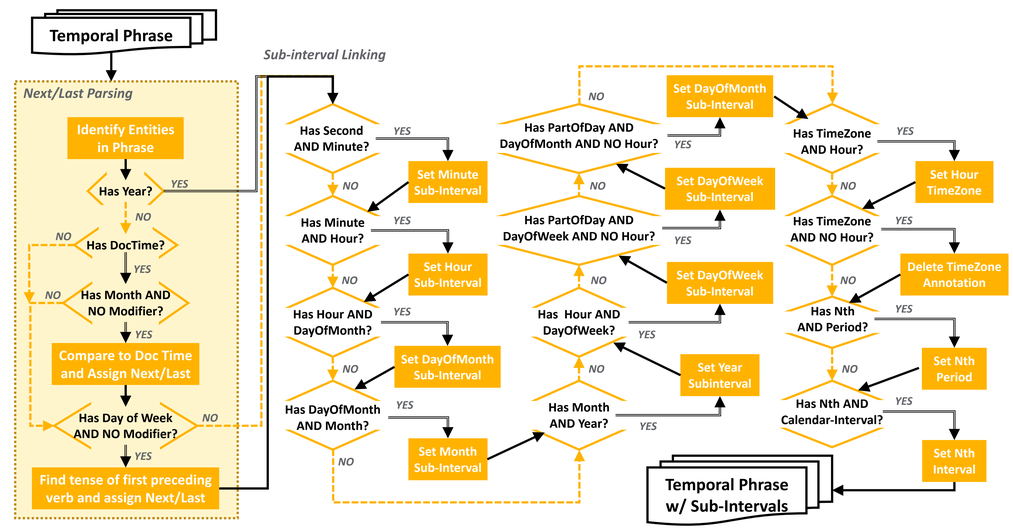
Chrono System Overview



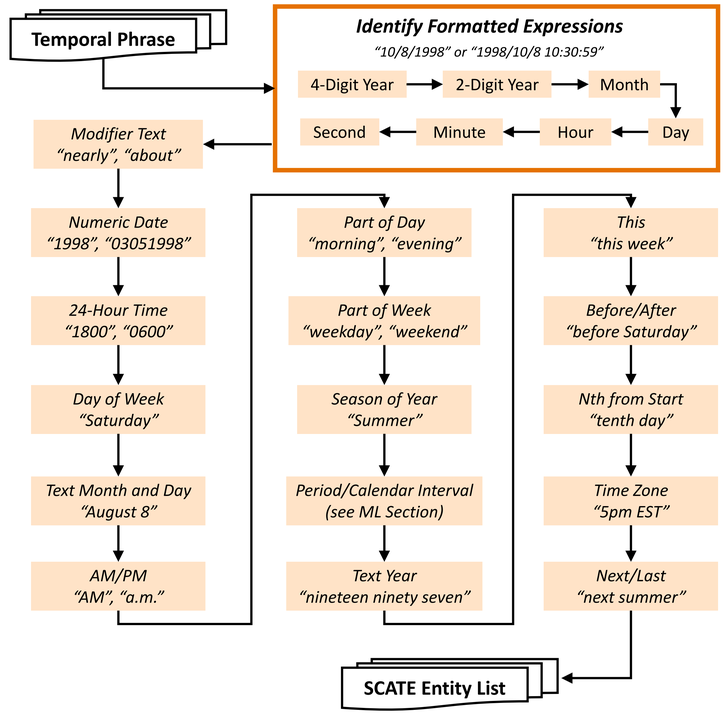
The Chrono System: Chrono[1] is a hybrid rule-based and machine learning system written in Python and built from the ground up to identify temporal expressions in text and normalizes them into the SCATE schema[2]. Input text is preprocessed using Python's NLTK package, and is run through each of the four primary modules highlighted here. Note that Chrono does not remove stopwords because they add temporal information and context, and Chrono does not tokenize sentences. Output is an Anafora XML file with annotated SCATE entities. After minor parsing logic adjustments, Chrono has emerged as the top performing system for SemEval 2018 Task 6[3]. Chrono is available on GitHub at https://github.com/AmyOlex/Chrono.

Future Work: Chrono is still under development. *Future improvements will include:* additional entity parsing, like "event"; evaluating the impact of sentence tokenization; implement an ensemble ML module that utilizes all four ML methods for disambiguation; extract temporal phrase parsing algorithm to be stand-alone and compare to similar systems; evaluate performance on THYME medical corpus; migrate to UIMA framework and implement Ruta Rules for portability and easier customization.

Entity Sub-Interval Linking



Entity Type Parsing Priority



Results

100% Correct Entity

ML Alg.	P	R	F1
NB	.686	.630	.657
NN	.684	.629	.656
DT	.687	.632	.658
SVM	.689	.630	.660

Correct Span

ML Alg.	P	R	F1
NB	.823	.752	.786
NN	.820	.749	.783
DT	.822	.751	.785
SVM	.827	.755	.789

Training Results: The average Precision, Recall, and F1 measures of 5-fold cross validation on the 81-document Newswire corpus show SVM as the top performing method; however, differences in scores were not statistically significant. Interestingly, Chrono achieves a higher F1 score across the board when only the location (*Correct Span*) of the SCATE entities was used for evaluation instead of all entity properties (*100% Correct Entity*), which indicates Chrono is correctly identifying many of the temporal entities, but it is currently unable to get all of the entity properties correct.

Evaluation Chrono NN

	P	R	F1
Evaluation	.46	.42	.44
Post-Evaluation	.61	.50	.55

Evaluation Results: The Neural Network method was chosen due to its superior performance on a subset of the larger training corpus. After a few logic adjustments (see paper) Chrono emerged as the top performing system for SemEval Task 6.

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